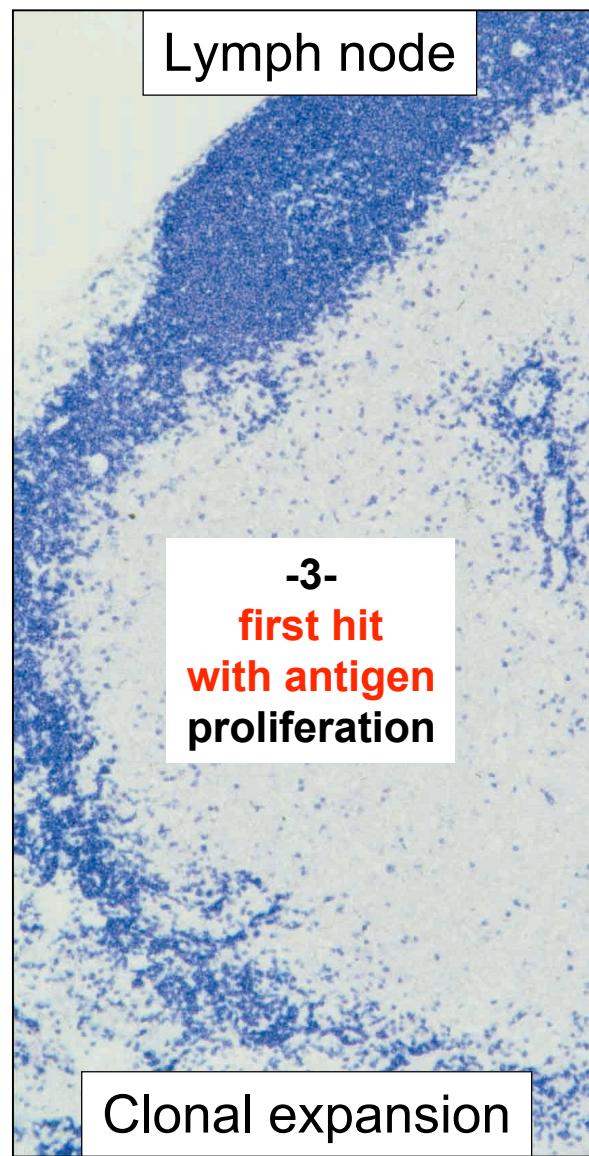
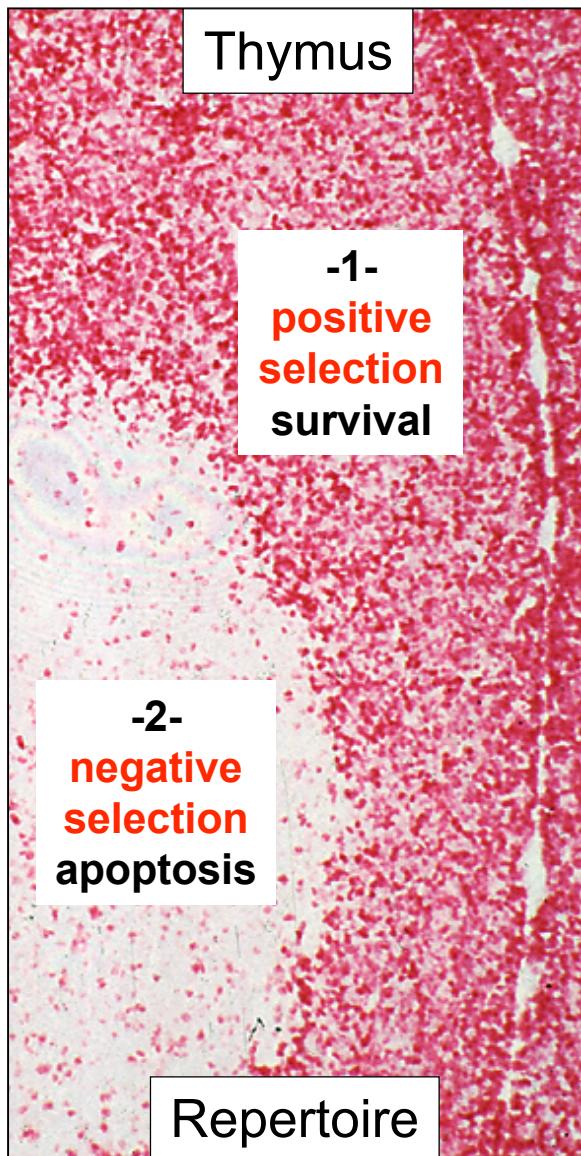




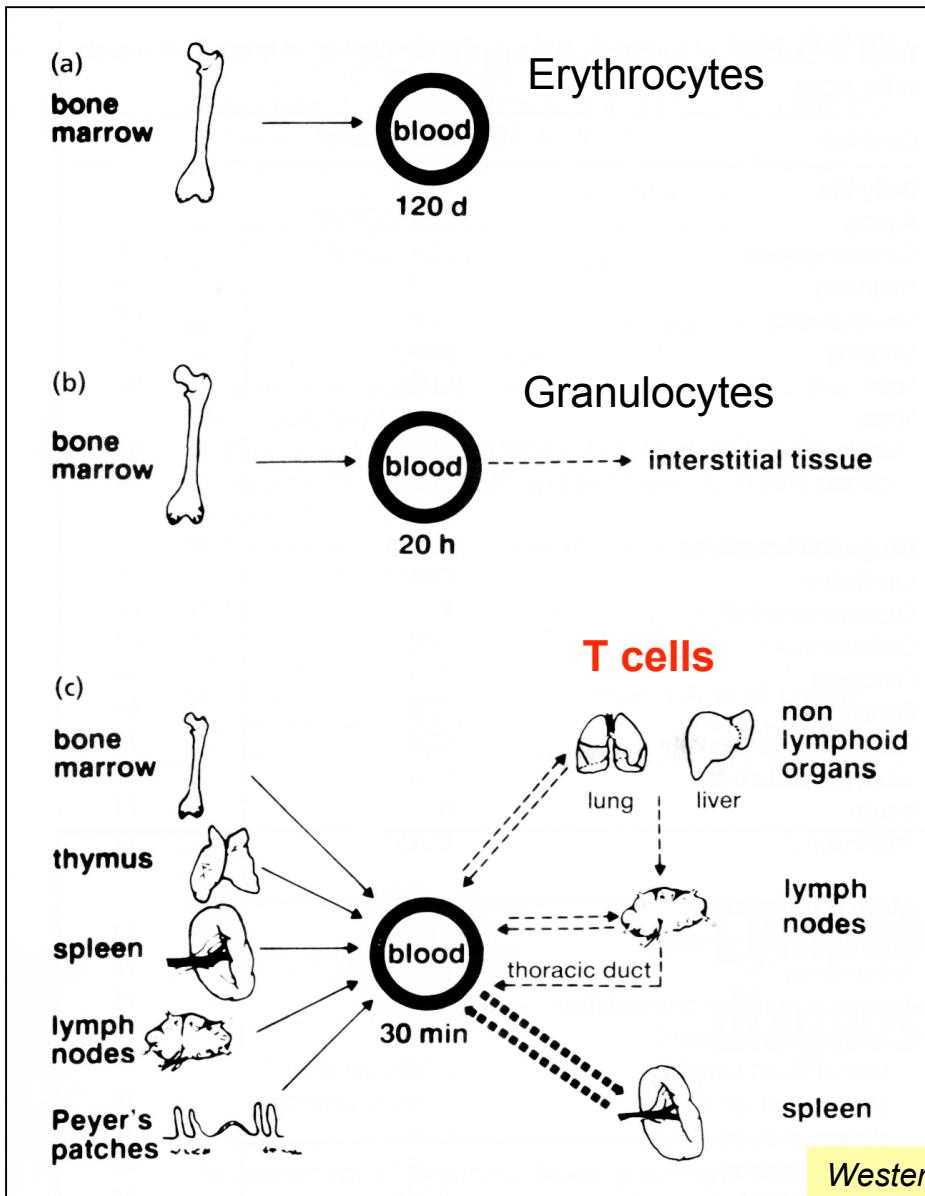
# Principles of T-cell migration: Facts and Fiction

Jürgen Westermann  
Institute of Anatomy, University of Lübeck

# Functional consequences of T-cell receptor ligation



# Migration of T cells



In man  
each day  
about  $500 \times 10^9$  T cells  
leave the blood  
and enter the tissues

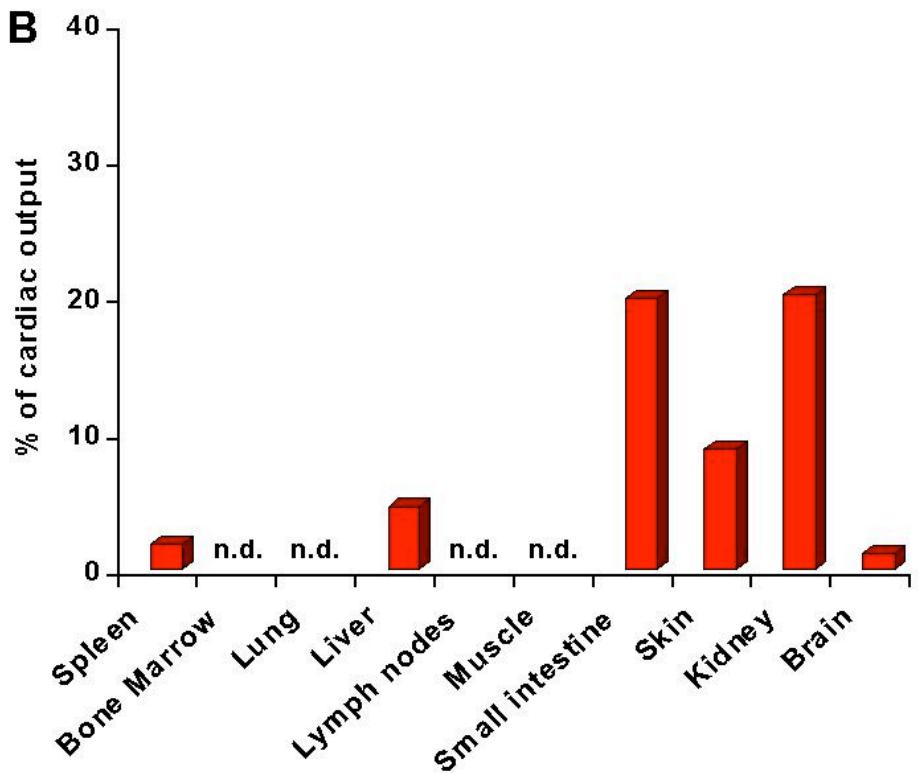
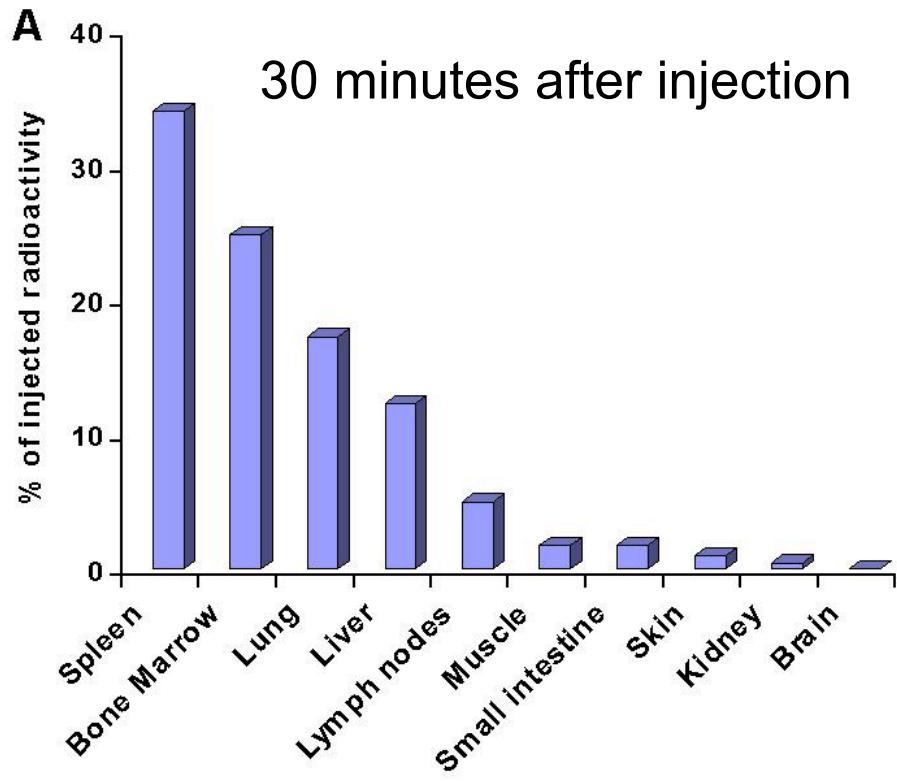
In animals about 0.005% of  
injected T cells are found in  
the brain: T cells are excluded

However, about 25 million  
T cells enter the brain each  
day:

→ Low percentages  
might matter!

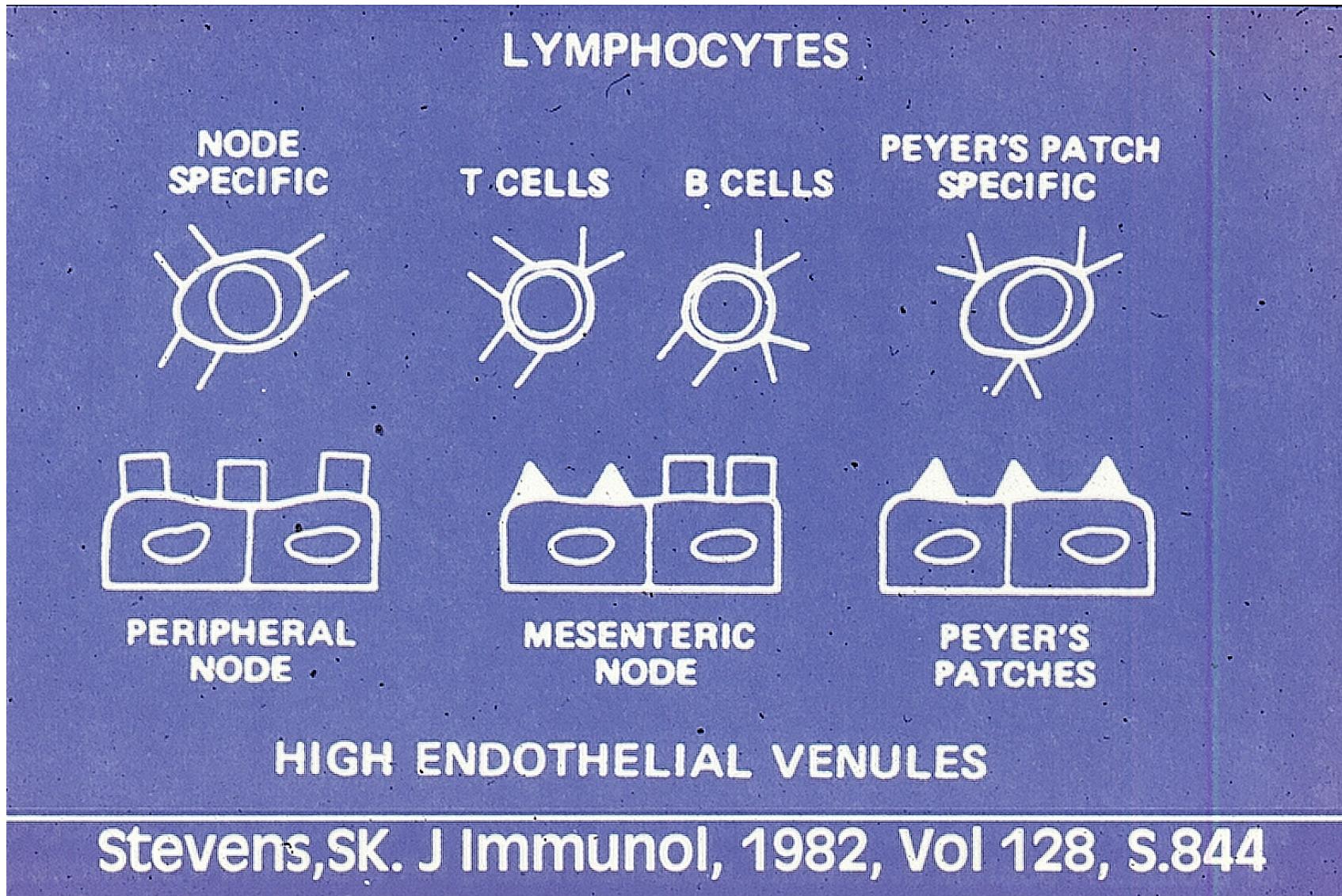
Westermann J, Pabst R. *Immunol Today* 1990; 11: 406-410.

# Migration of T cells

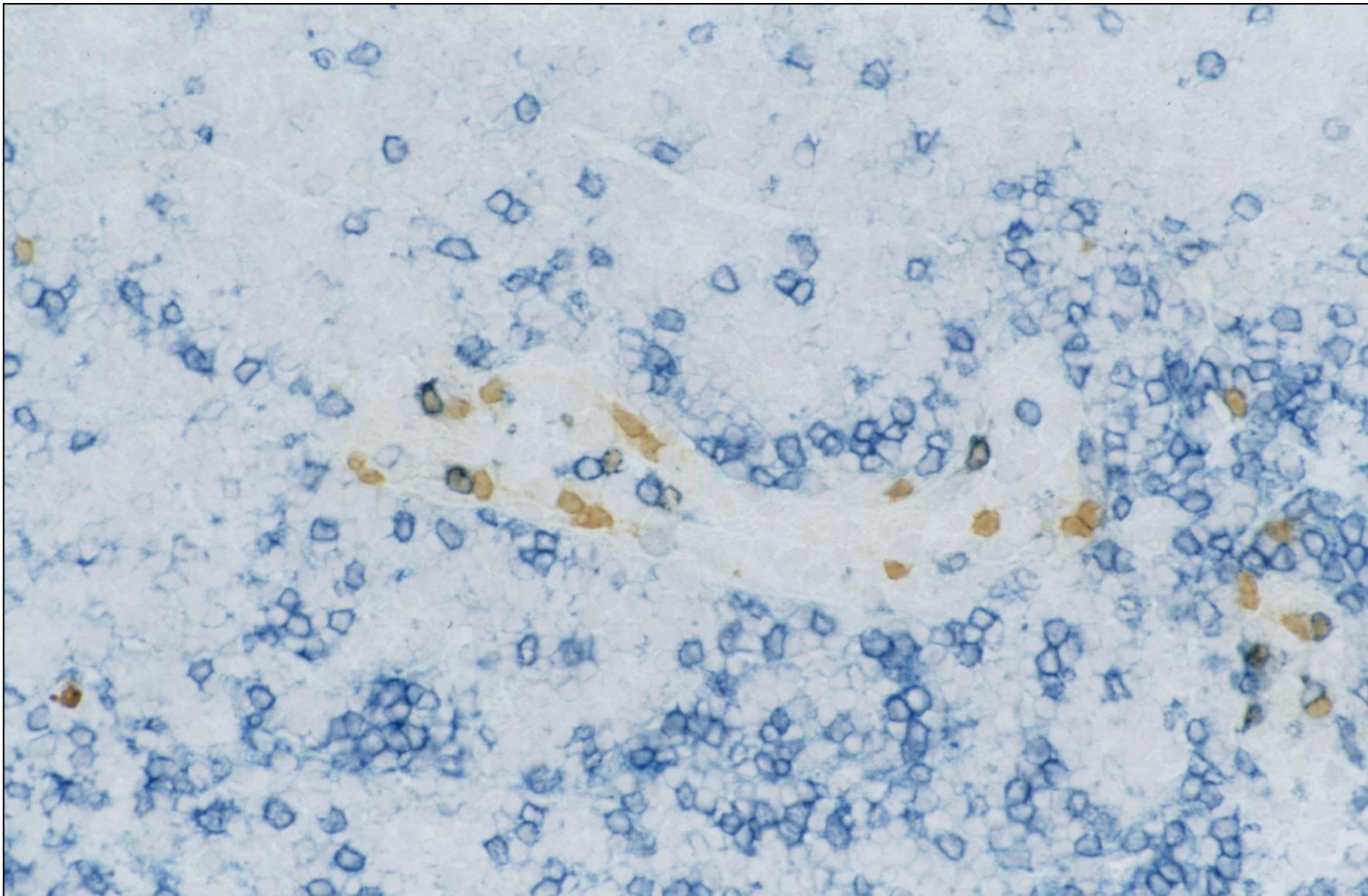


Rannie GH, Donald KJ. *Cell Tissue Kinet* 1977; 10: 523-541.

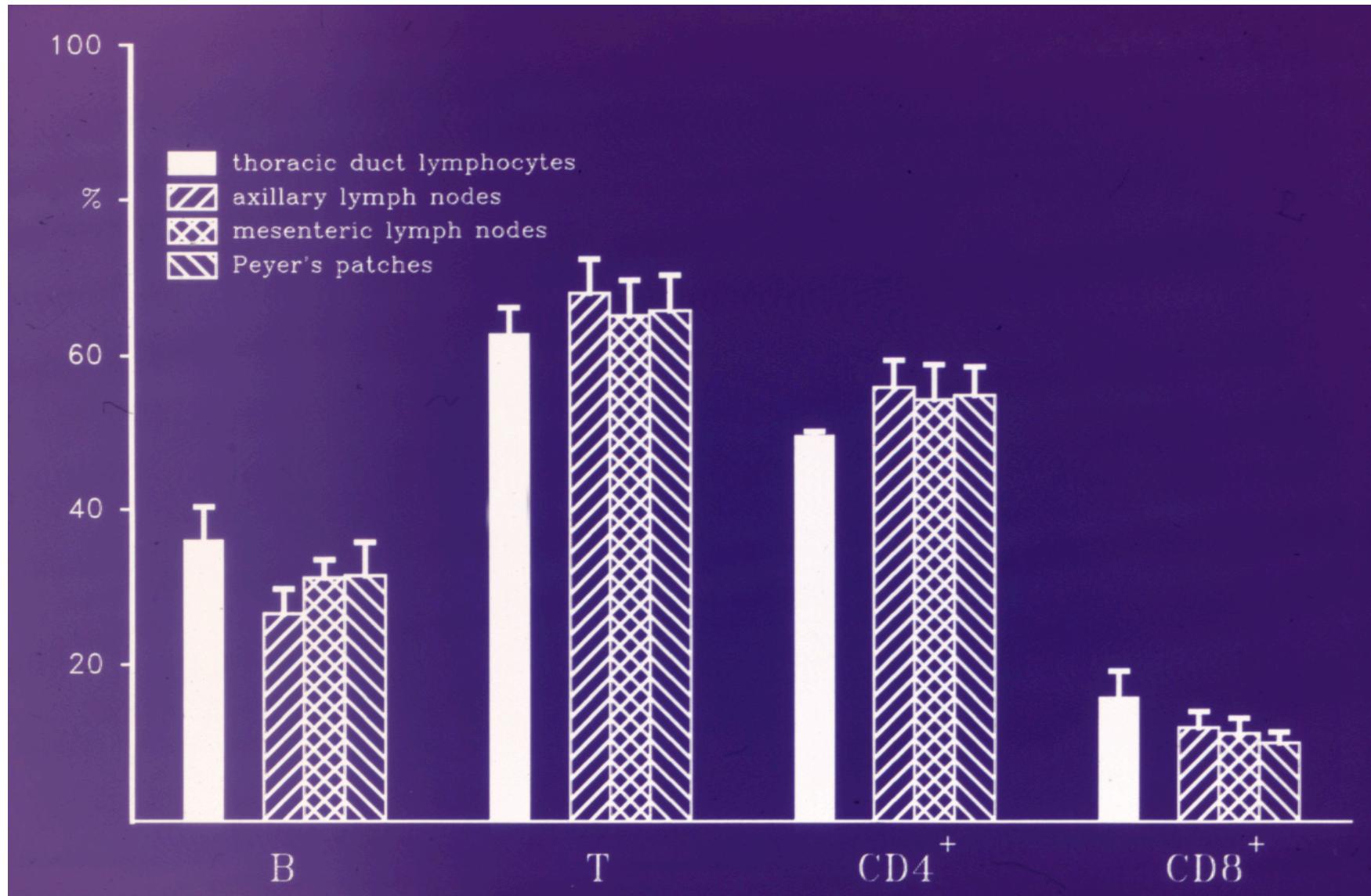
# Molecules regulating T-cell migration



# Molecules regulating T-cell migration

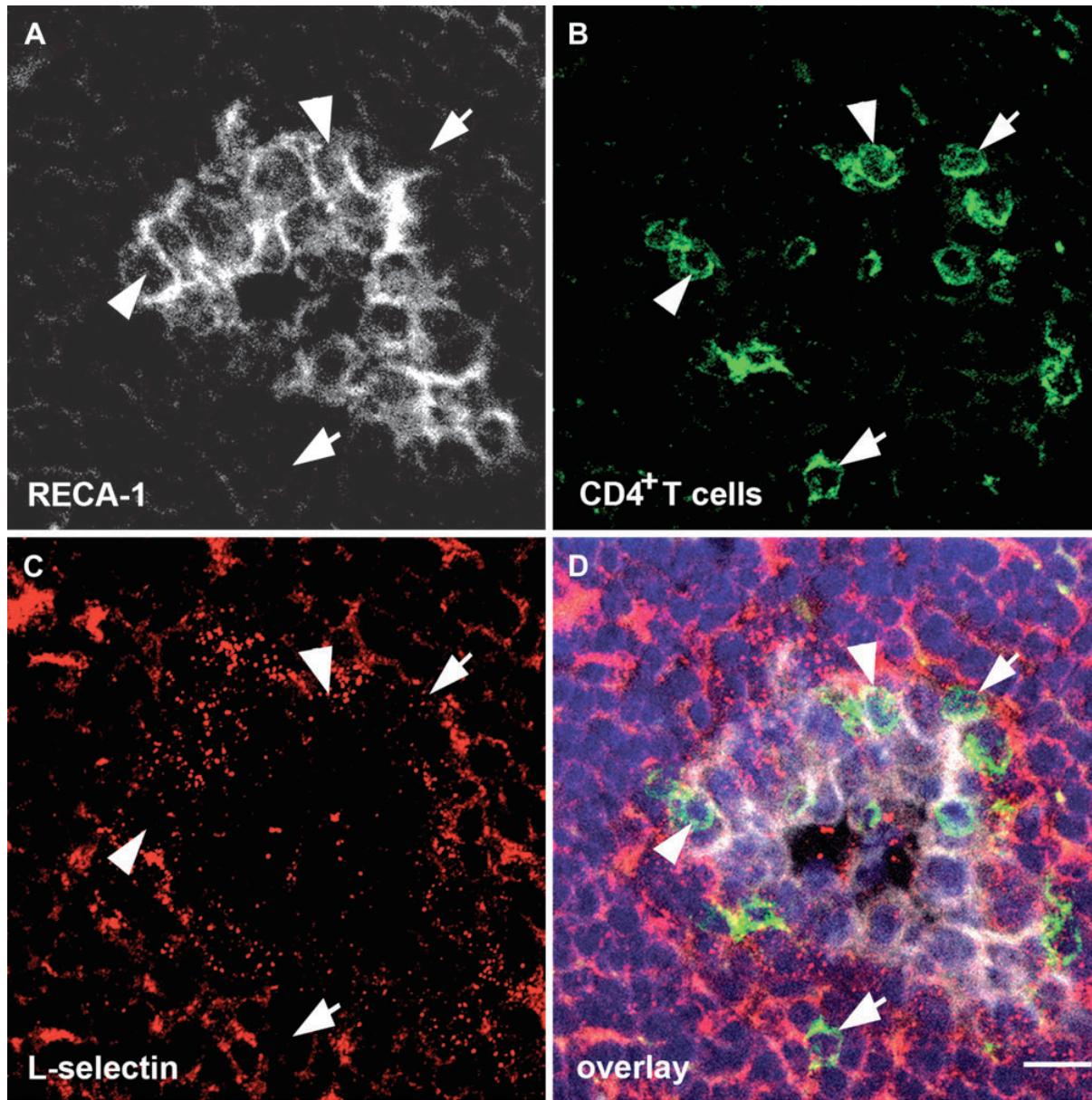


# Molecules regulating T-cell migration

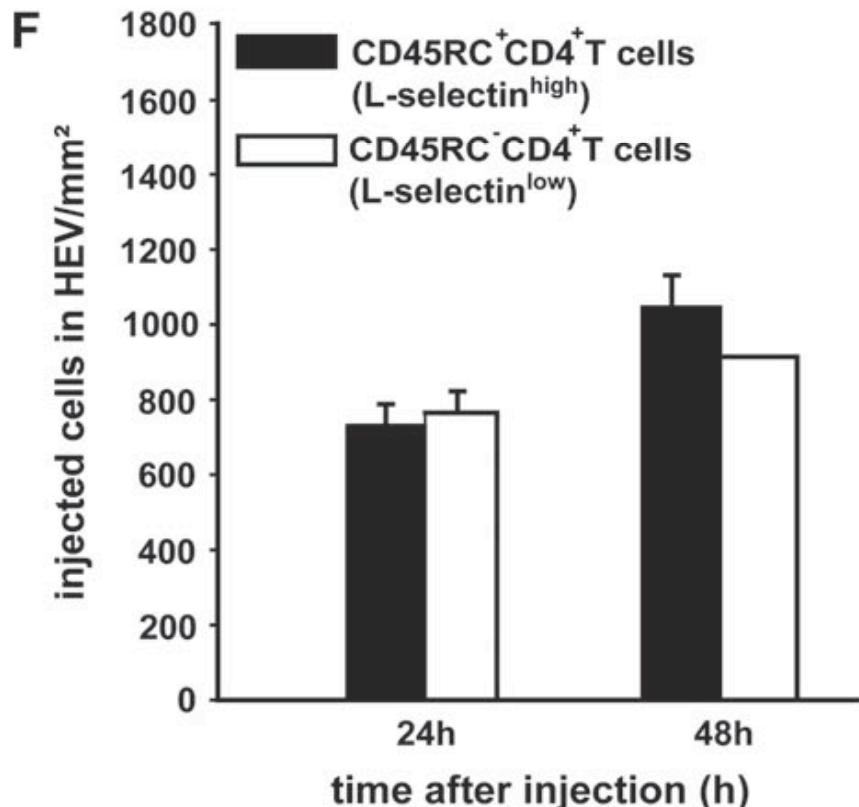


Westermann J et al. *Eur J Immunol* 1992; 22: 2219-2223.

# Molecules regulating T-cell migration



# Molecules regulating T-cell migration



## Prediction not possible

- Expression level
- Active/inactive form
- Position
- Hen/egg problem

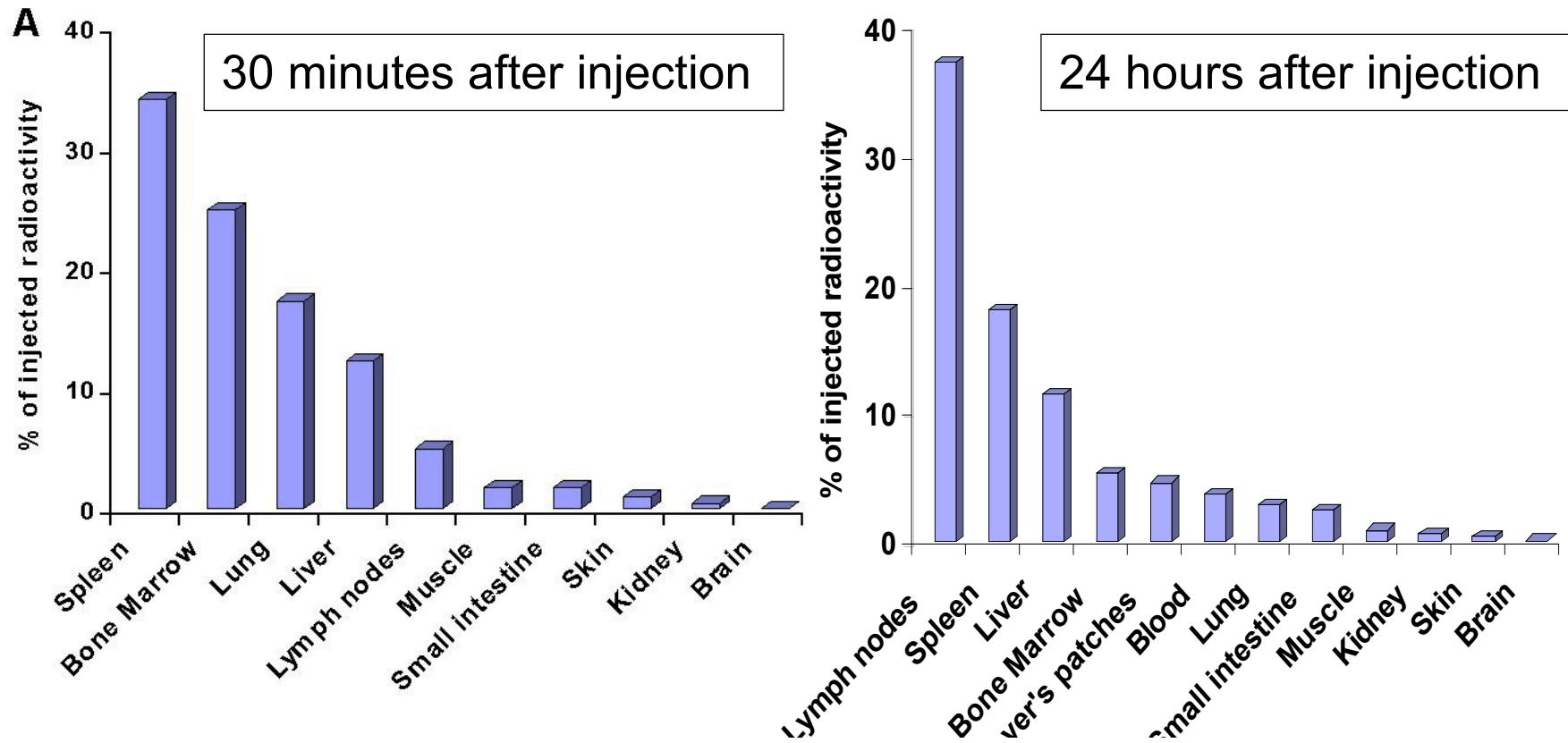
→ Proof of principle experiment necessary:

blood lymphocytes  
thoracic duct lymphocytes  
(e.g.: S1P, L-selectin)

Summarized in:

Westermann J et al. *Ann Int Med* 2001; 135: 279-295.

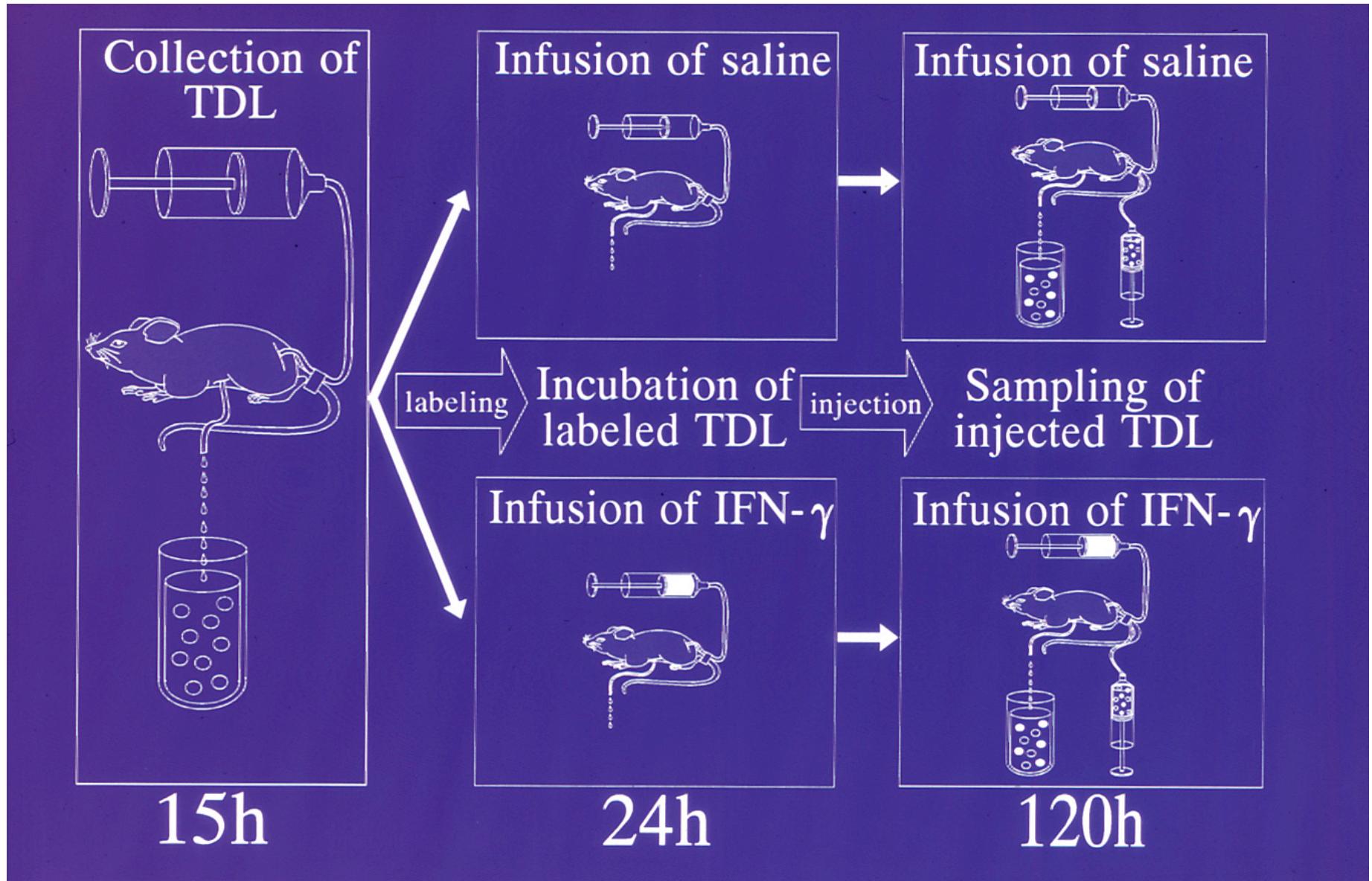
# Resting T cells accumulate only in lymphoid organs



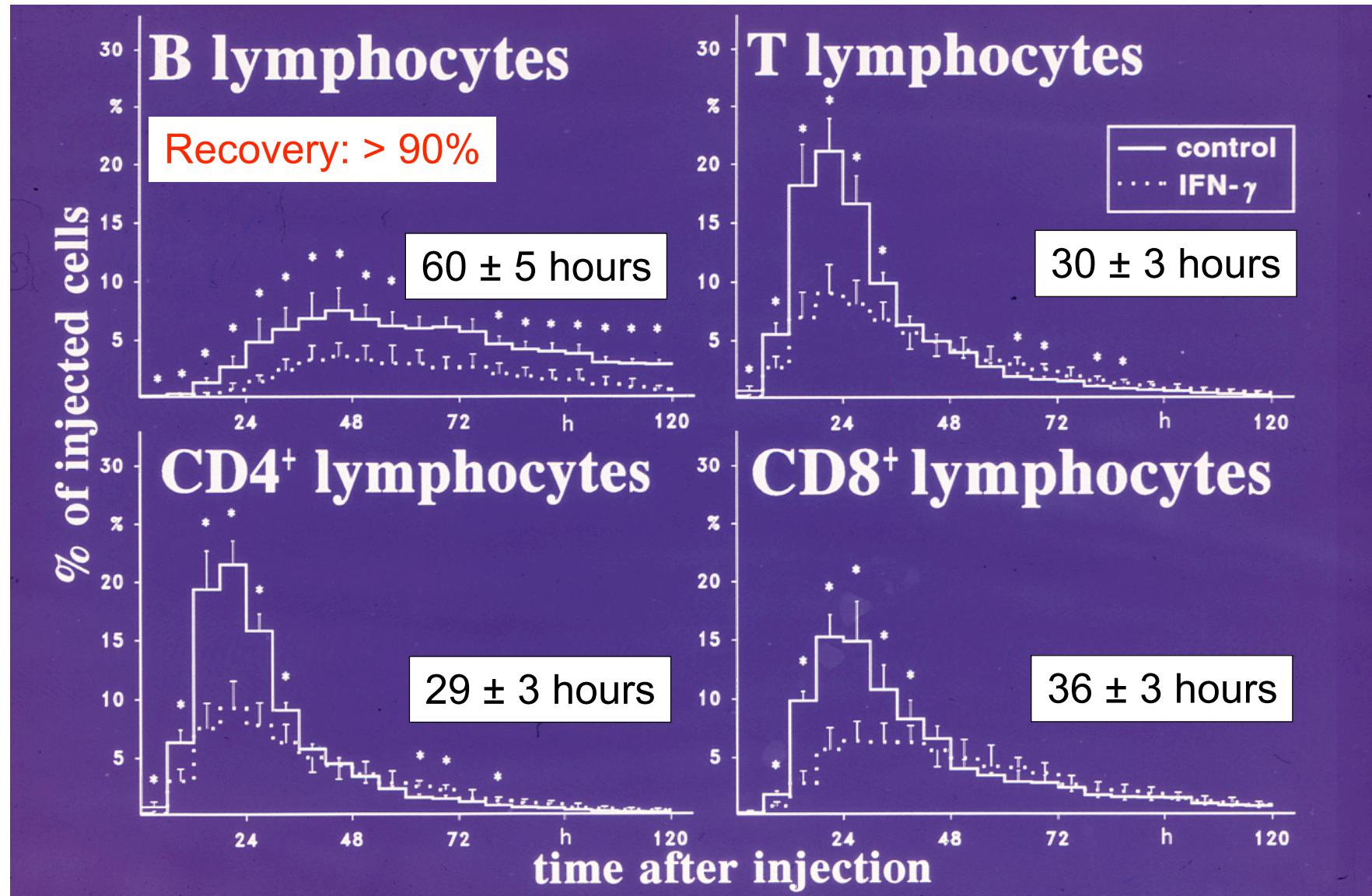
Rannie GH, Donald KJ. *Cell Tissue Kinet* 1977; 10: 523-541.



# T-cell migration: blood - lymph nodes - blood

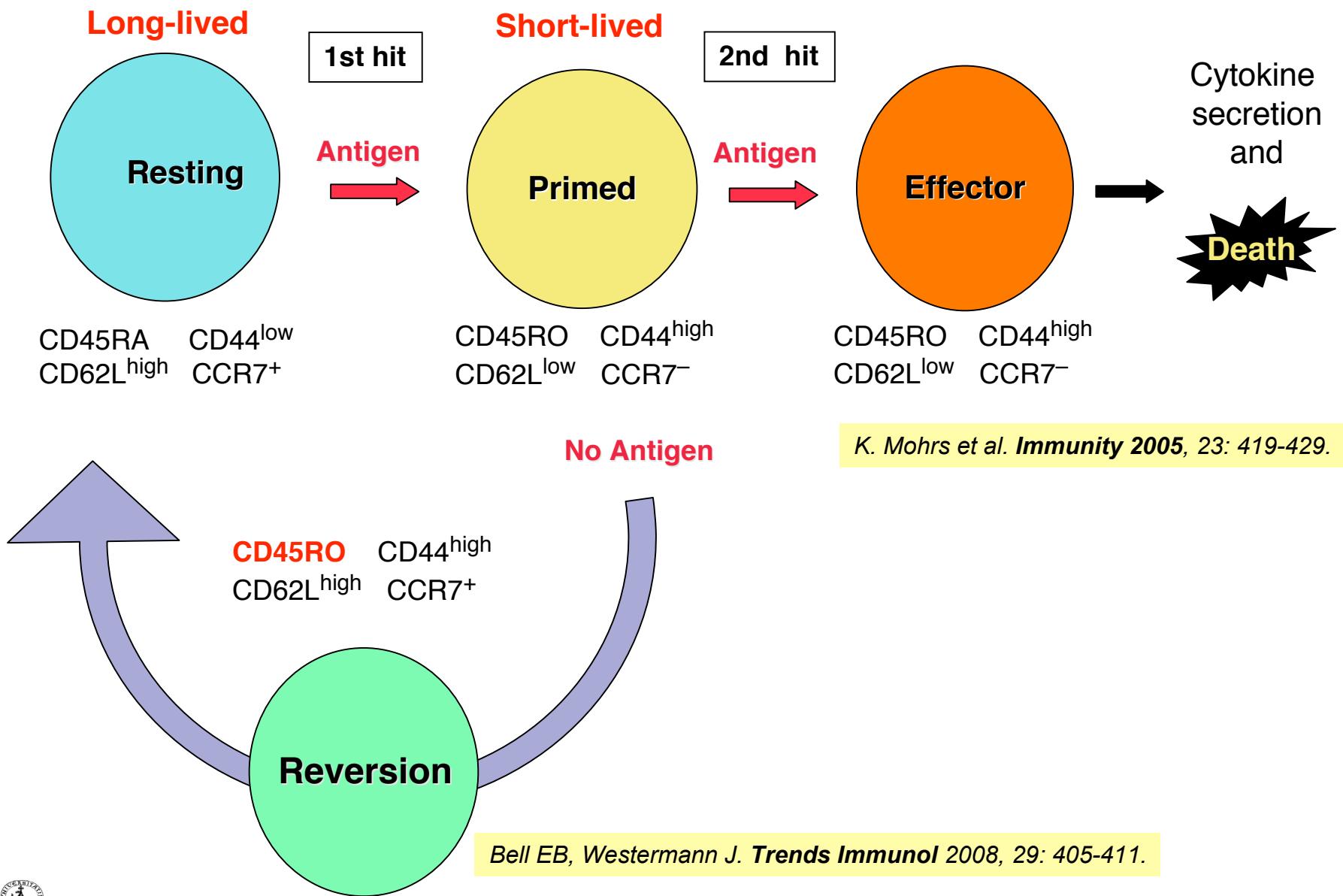


# T-cell migration: blood - lymph nodes - blood

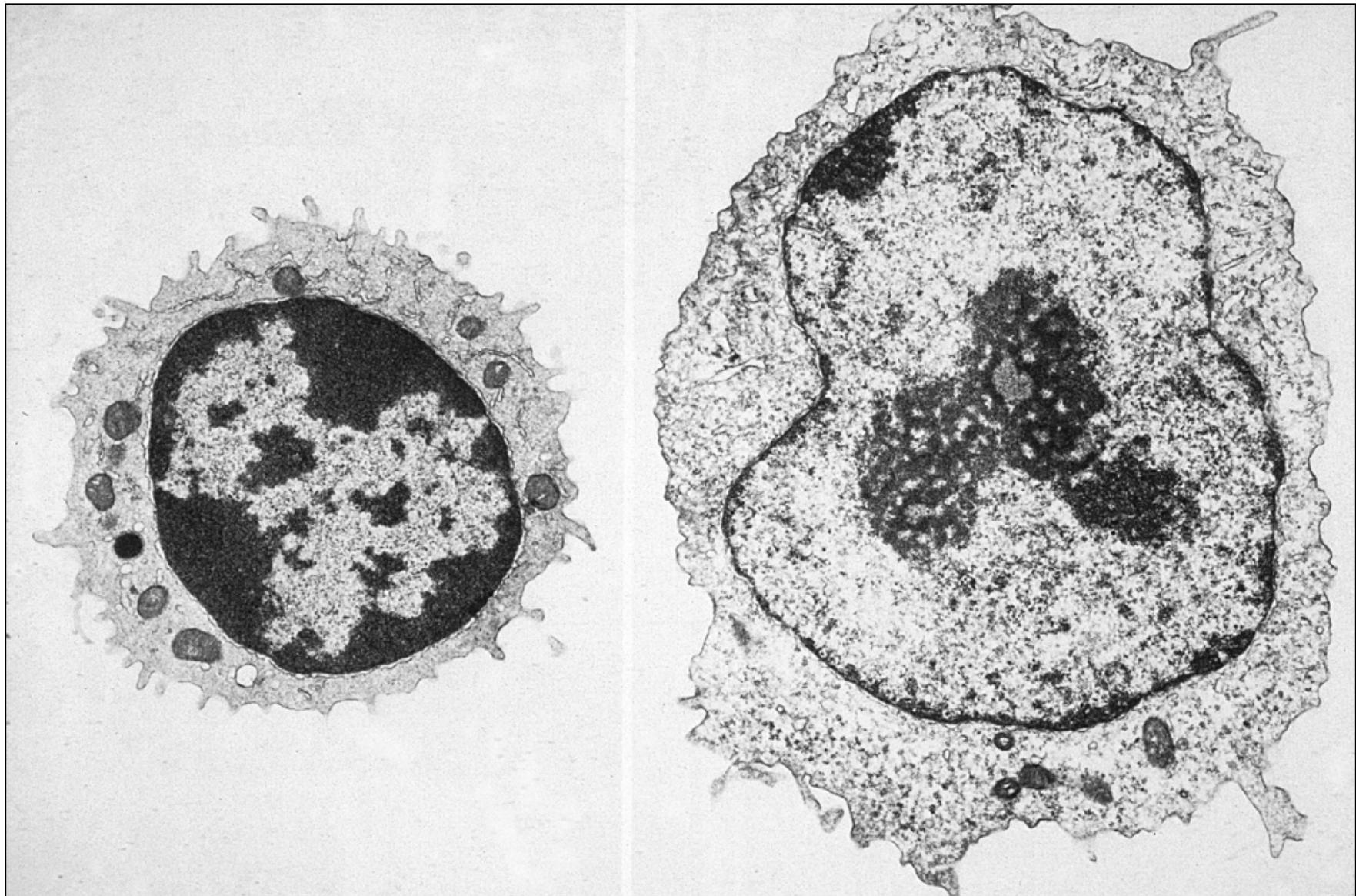


Westermann J et al. *J Immunol* 1993; 150: 3843-3852.

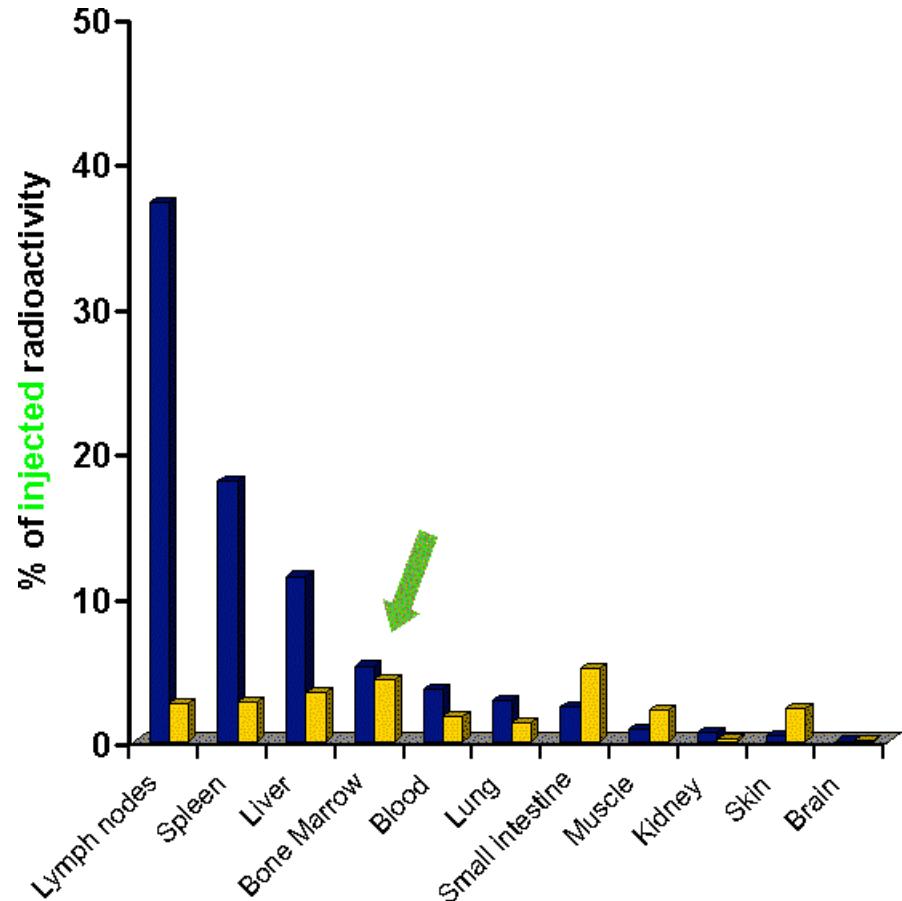
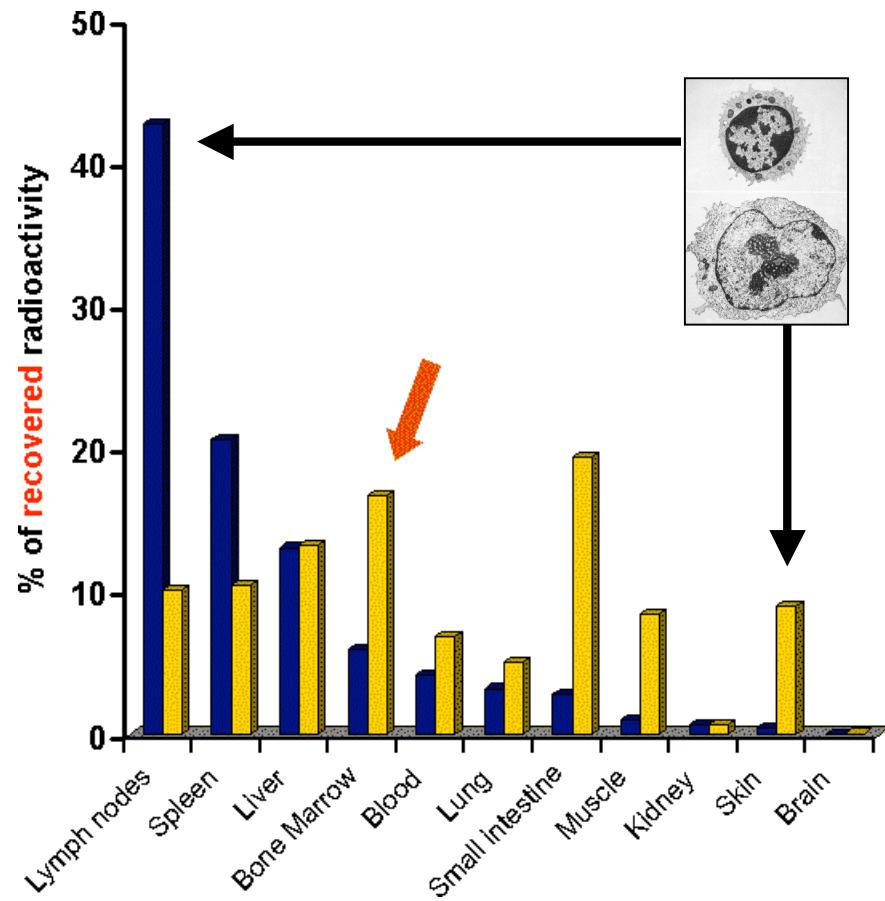
# Phenotypes of CD4 T cells



# Distribution of resting and activated T cell *in vivo*

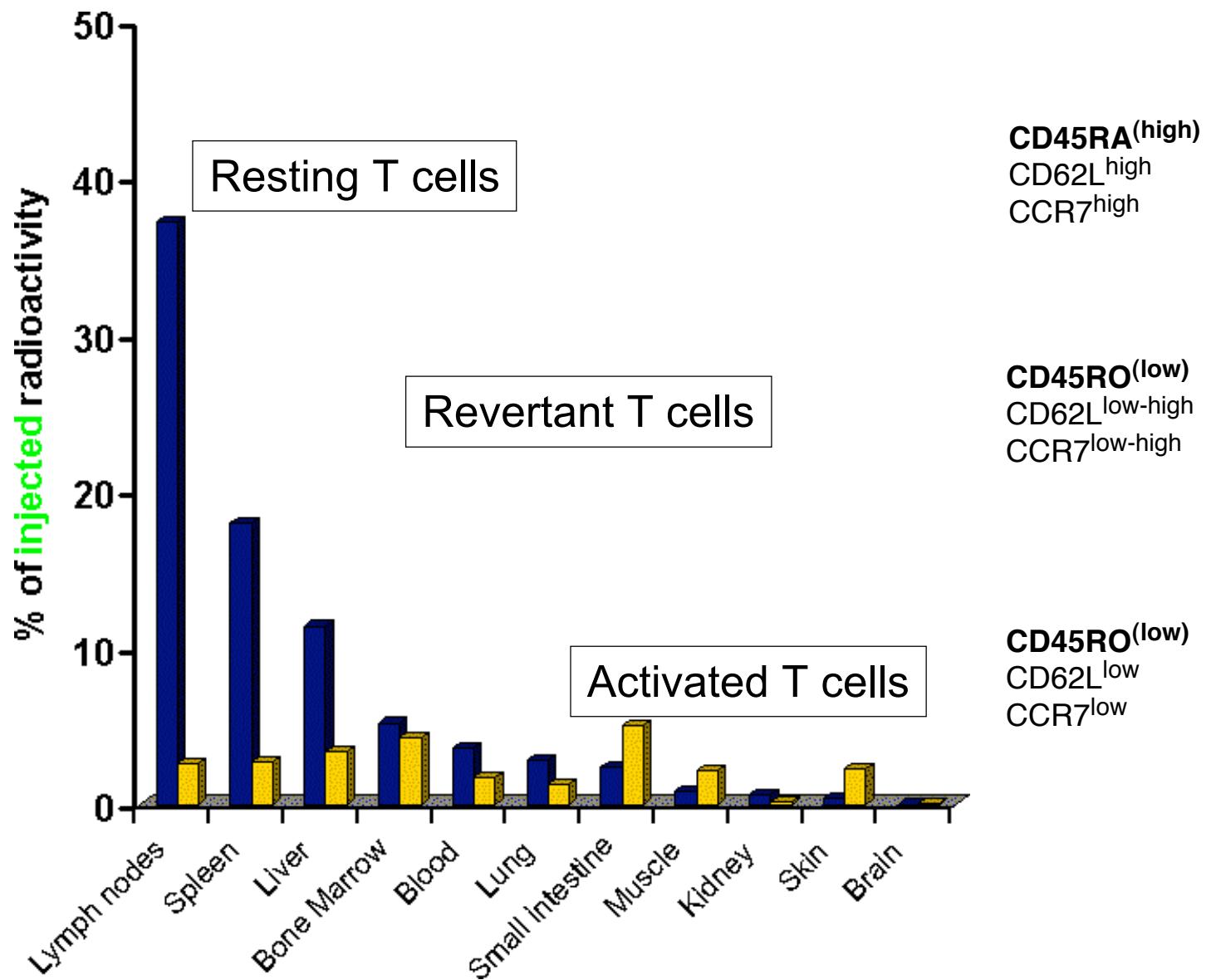


# Distribution of resting and activated T cell *in vivo*

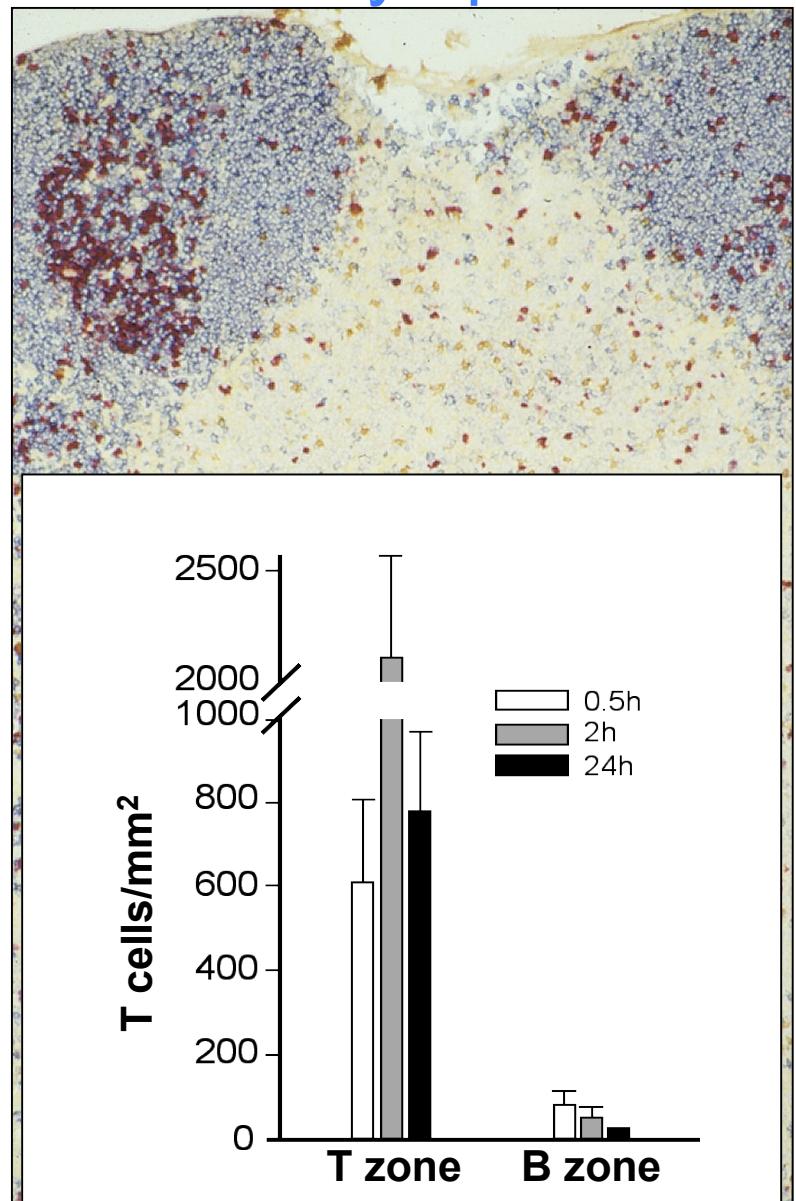
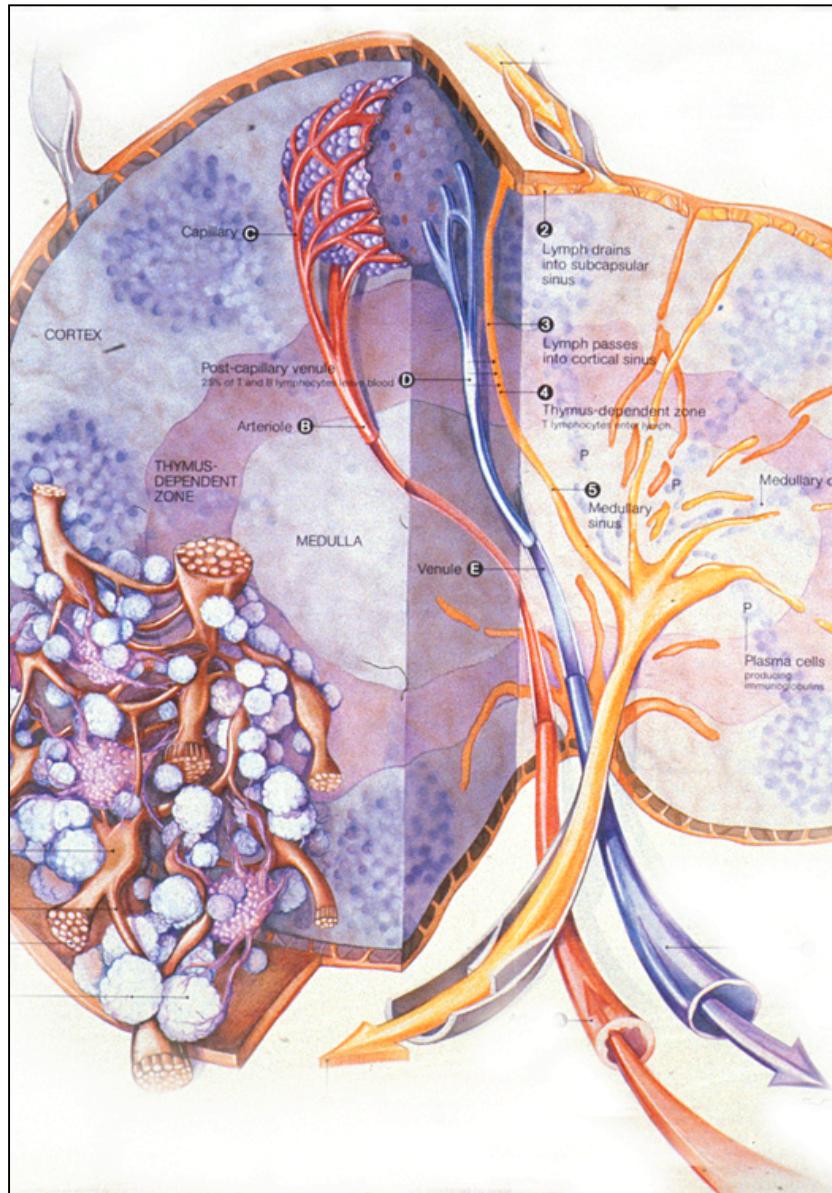


Westermann J et al. *Lab Invest* 2003; 83: 459-469.

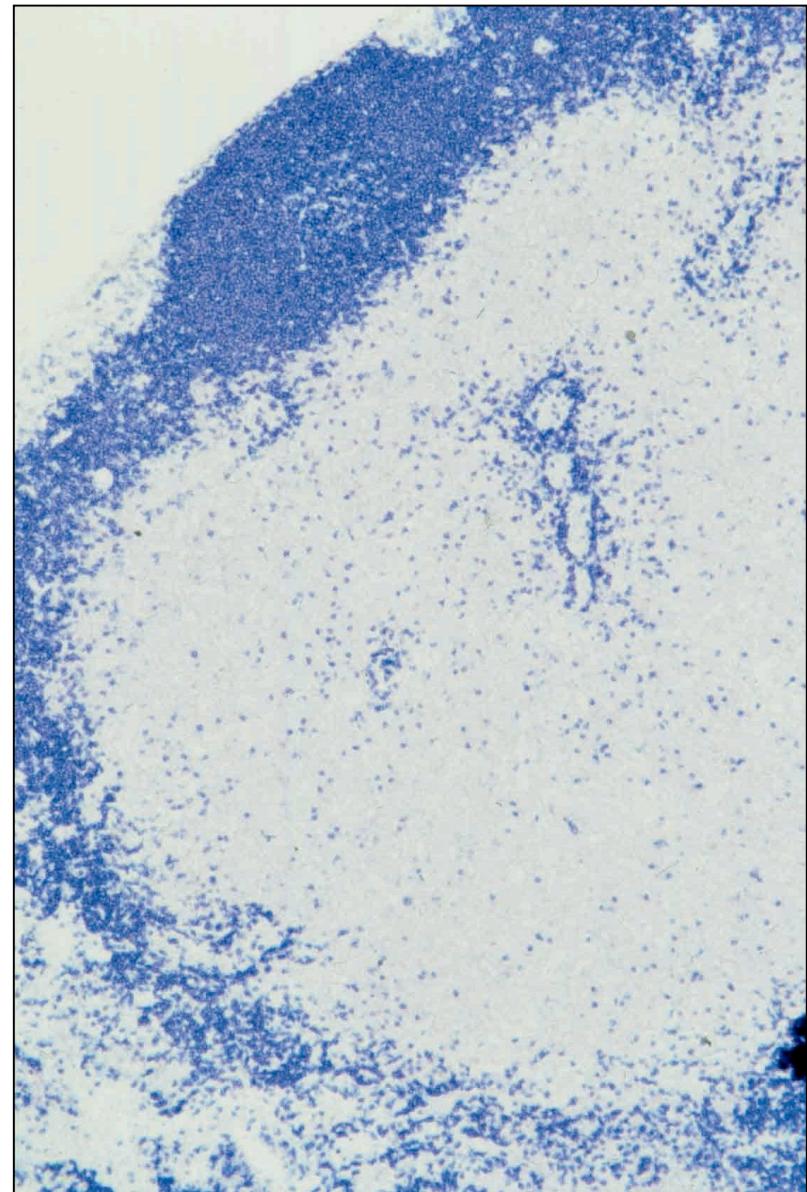
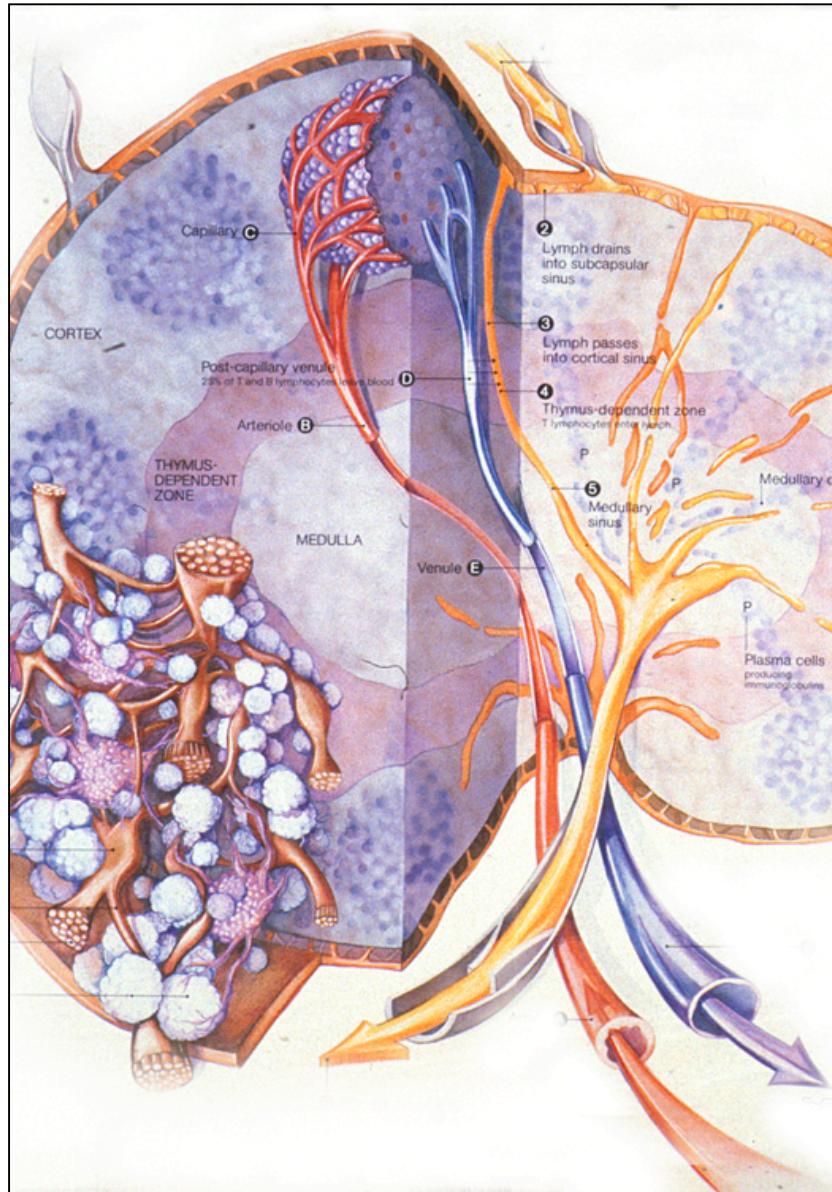
# Two principle patterns of T-cell migration



# Compartment-specific migration within lymph nodes



# Compartment-specific migration within lymph nodes



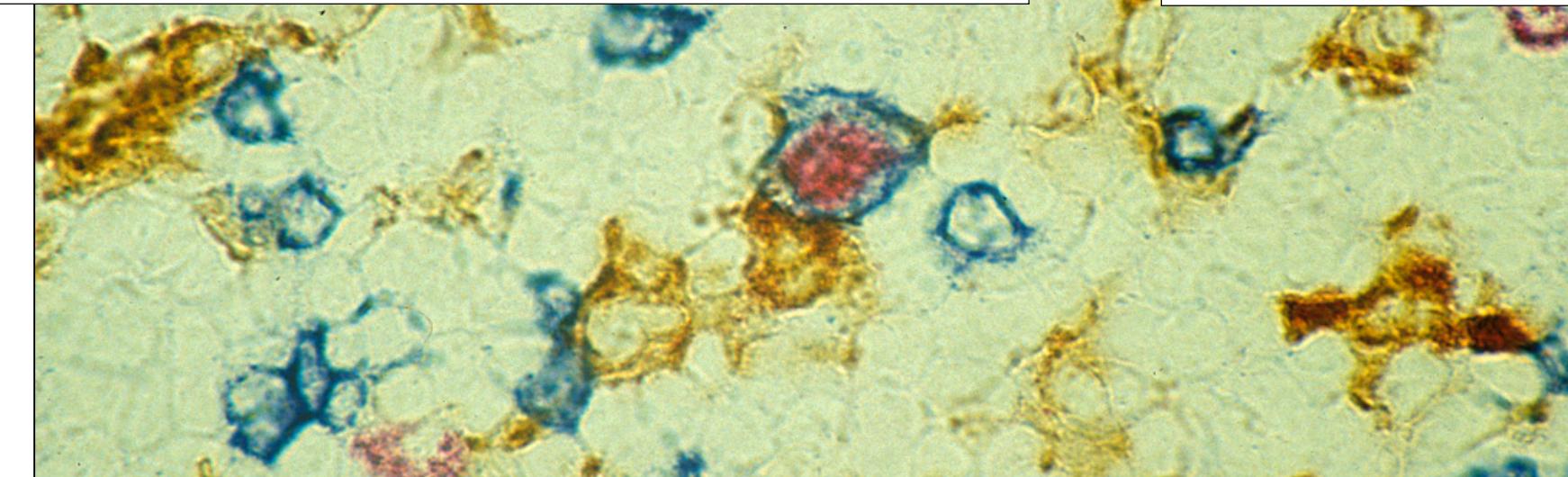
# Conclusions

## Microscopic scale

- Visibility of environment (compartments, cells)
- Migration characteristics (directed, random):  
**T/B migration**

## Macroscopic scale

- Entry rate
- Mean transit time:  
**R/A migration**



## Clinical implications

- Entry: 30.000  $\mu\text{m}/\text{min}$
- Transit: 15  $\mu\text{m}/\text{min}$

## Open questions

- Life span of T cells
- Definition of subsets

